Background

Due to several recent NASA mission failures, the NASA Administrator has requested that each Center Director conduct a critical Red Team Review of each of that Center's missions prior to launch. The Administrator wants each review to go beyond a consideration of the project's documentation of what was done and into the technical aspects of the project and the residual risk at launch. This review will include the launch vehicle and KSC will provide the appropriate managerial and technical expertise to support the review. KSC will also recommend an external, independent launch vehicle expert to serve on the Red Team.

This Charter is responsive to the Administrator's request.

Objective

The objective of this review is to enhance the probability of a fully successful EO-1 mission by bringing to bear additional technical expertise to review all mission-critical aspects of the EO-1 project in order to better appreciate the aggregate residual risk existing prior to launch.

Scope

This Charter is applicable only to the EO-1 mission.

Review Concept

The Red Team Review will be a critical technical review of the implementation and planned operations of the EO-1 mission from the perspective of looking at what could go wrong and cause the mission to be less than fully successful. Both the key processes used by the project to implement the mission and the results of these processes shall be reviewed and assessed. From this information the Red Team shall identify and document all residual risk that could significantly affect mission success.

At GSFC, several Red Teams shall be assembled and staffed by experienced technical and project management experts. The team will have a membership that is independent of actively working GSFC personnel. A core team of external, independent experts will be maintained and additional disciplinary experts will be added as appropriate. The core team, which will include independent launch vehicle expertise recommended by the KSC, will function as an overview team that will assign work to specialized technical splinter teams as appropriate. However, the core team is responsible for the implementation of the Red Team Review and shall direct the project and the technical teams as necessary.

In those missions where there is an active External Independent Readiness Review (EIRR), the EIRR can serve as the Red Team assuming it is willing to adopt this Charter for the purposes of conducting the Red Team Review.

The EO-1 Project shall assemble all pertinent information and present it to the EO-1 Red Team. It is expected that this review shall take four days followed by an additional two weeks allocated for deliberations, additional data requests, and final report preparation by the Red Team. The Red Team Review will occur sometime after the final Comprehensive Performance Test but before the spacecraft is shipped to the Vandenburg Air Force Base. On this basis, the review is anticipated to occur during the week of March 20, 2000. Following the review, the Chairman will consult with the membership of his Board and then provide a verbal recommendation to the GSFC Deputy Center Director as to whether the EO-1 Project should proceed with shipping. The Red Team Final Report will be presented by the Chairman at the EO-1 Mission Readiness Review (MRR) that will occur in mid-May. The Red Team shall have the authority to request that the Project prepare all necessary documentation and other records to enable and otherwise support these reviews. The Project shall also arrange for the cognizant peer review

and systems review chairpersons to present the methodologies and findings of the individual reviews to the Red Team.

Since the Chairman of the EO-1 Senior Manager's Review (SMR) is also the Chairman of one of the GSFC Red Teams, members of the EO-1 SMR will be involved in the EO-1 Red Team Review at the discretion of the SMR Chairman and the Chairman of the EO-1 Red Team. Any inputs they choose to make will be made to the EO-1 Red Team Chairman and their Final Report will be combined with that of the Red Team and reported at the EO-1 MRR by the Red Team Chairman.

Members of the GSFC Office of Systems Safety and Mission Assurance that have been previously involved in EO-1 system-level reviews will support the EO-1 Red Team Review and be available to answer any questions posed by the Red Team. A Δ Pre-Ship Review previously agreed upon with the Office of Systems Safety and Mission Assurance will be superseded by the EO-1 Red Team Review. Any input these members choose to make at the Red Team Review will be made to the Red Team Chairman. Their final recommendations will be voiced by the Director of the Office of Systems Safety and Mission Assurance at the EO-1 MRR.

EO-1 Mission Overview

The New Millennium Program (NMP) sponsors a series of technology validation missions that are designed to lower the cost and increase the performance of future science missions by significantly accelerating the incorporation of advanced technologies into these new missions. A technology validation mission typically contains 6-12 advanced technologies to be validated on orbit. This process is captured in a separate validation plan for each of the technologies to be validated. As reflected in the validation plan, technologists and engineers first demonstrate that the new technology performs as expected followed by scientists demonstrating that the technology supports the science for which the new technology is intended. These validation activities have both a substantial ground-based component and a flight component. After the flight, all of these validation data are gathered into technology transfer documentation that is the basis for subsequent technology infusion into future missions.

In contrast to a science mission, a technology validation mission acquires much of its necessary validation data prior to launch. Moreover, the flight phase of most validation plans can be completed in a few months such that the operational phase of a technology validation mission is considerably shorter than that of a typical science mission. The shorter operational phase combined with the reduced dependence on flight data justifies single-string designs as a baseline for technology validation missions. This position serves to streamline the design, reduce the complexity, shorten the development time, and to lower the cost of these missions. However, it does increase the risk and thereby becomes a pertinent topic for this review.

The NMP's first Earth-observing mission (EO-1) will flight validate 13 advanced technologies applicable to future land imaging missions. It is fully responsive to the Land Remote Sensing Policy Act of 1992 wherein NASA is charged to "ensure Landsat data continuity" through the use of advanced technology. The EO-1 mission was approved on March 22, 1996 and it will launch in early June 2000. The thirteen technologies will be flight validated within one year of launch. The cost of the mission is approximately $175M, including the launch vehicle and all of the technology validation activities.

EO-1 Mission Elements

The mission elements to be presented to the Red Team Review and the depth of detail of each element presentation is as follows:

EO-1 MISSION ELEMENTS	
MISSION ELEMENT	**DEPTH**
Instrument Technologies:	
Advanced Land Imager	Fully
Hyperion	Fully
Atmospheric Corrector	Fully
Spacecraft:	
Subsystems	Fully
Technologies	Fully
Launch Vehicle:	
Design	Mission-Unique
Integration	Fully
Safety	Fully
Operations:	
Initial Operations	Fully
Routine Operations	Mission-Unique
Science Validation	Data Flow Only

Review Process

For all of the mission elements specified above, the EO-1 Project shall present data that addresses the following:

1. The level, competence, and independence of technical peer reviews that were performed on each of the mission elements.

2. The performance, level, and independence of system level reviews that were conducted.

3. The level and thoroughness to which the test and verification program was implemented. The test and verification program at all levels from black box to spacecraft and integrated mission shall be detailed. This shall also include the V&V and IV&V processes used on software.

4. The level of product assurance that was imposed on the implementation of the element. This shall include parts usage as well as workmanship standards imposed. It shall also address the software assurance processes implemented.

5. The systems management imposed and implemented by the mission. This shall include the performance and thoroughness of analyses, requirements management, systems engineering, software metrics, configuration management, documentation and technical record keeping, workmanship, and test process management.

6. Provide a mission requirements Verification Matrix that shows the pre-launch verification of the mission-level requirements. This matrix shall address both the fidelity and type of verification.

7. Factors such as staffing and the experience of the implementing organization.

8. The results of the test and integration process of all of the hardware and software associated with the mission element. This shall include information on the review and assessment of all significant failures and anomalies and their resolution.

9. Information on the failure-free as well as the total operating time on all mission critical hardware and software.

10. The results of the technical review process shall be detailed. It shall include an assessment of all significant RFA's and the Project responses to those RFA's.

11. The amount, level and fidelity of mission simulations and launch/operations training that was done or is planned to be done to prepare the mission for launch and on-orbit operations.

12. Use three system engineering tools, the Failure Modes and Effects Analysis (FMEA), Fault Tree Analysis, and Probability Risk Assessment to quantitatively evaluate the residual risk of the EO-1 mission, particularly the EO-1 Minimal Mission.

13. Identify all single-point failures and provide a subjective assessment of the probability of each such failure mode causing a mission failure. Also provide adequate rationale to substantiate the subjective assessment.

In reviewing the above items, the Red Team will focus on implementations that could contain unevaluated risk to mission success.

Red Team Responsibilities

The Red Team shall review the EO-1 mission as a technology validation mission and not as a science mission. The role of single-string designs as a baseline for such missions should be specifically considered.

1. Document the above review investigations in a summary matrix that indicates actual level of performance achieved on each of the above items. This should take into account the level of difficulty and complexity of the mission. Each of these items shall be rated on a scale of 1 to 10 with 10 being a superior implementation and 7 being judged as the norm expected for assuring a residual risk that could be categorized as low. Each and every lapse in adequate implementation (a scoring of 6 or lower), even if the overall implementation is judged as being adequate, shall be identified and documented and judged under Item #2 below. Potential viable mitigation of remaining risk shall also be addressed if applicable.

2. Ascertain and document all residual risks, judged to be any level higher than low, that are remaining in the mission. Provide recommendations on methods and implementations to mitigate these identified higher-than-low risks.

3. Assess all single-point failure mechanisms and provide a recommendation on the acceptability or non-acceptability, with appropriate rationale for each conclusion. The Red Team should specifically consider the Wide-band Advanced Recorder/Processor (WARP) as a single-point failure and whether all practical mitigating alternatives have been identified and considered.

4. Assess the Project provided FMEA, Fault Tree Analyses, and the Probability Risk Assessments for completeness and assign levels of probability of occurrence and mission risk to each failure mode. (High, Medium, Low)

5. Provide a full report of all of the above to the Center Director and the Goddard Program Management Council at the EO-1 MRR. This report shall also have the Project provided FMEA and Verification Matrix attached.

6. An overall mission risk statement, along with the justification for that statement, shall be made in the report.